Space Weather Technical Forecast

Issued on Thursday, 18 August 2022 at 00:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor storms expected Day 1 and likely on Day 2, with a chance of G2/Moderate storm, mainly Day 1. Further Moderate flares (R1-R2 Radio blackouts) likely throughout. Active electron fluence on Day 1 likely declining.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with two M-class flare observed in the past 24 hours. This was from AR3078 (Dkc/Beta-Gamma-Delta) in the southwest quadrant (M2.0 at 17/1345 UTC). There are currently five numbered sunspot regions and two small un-numbered on the visible disc at present. AR3078 in the southwest quadrant remains the largest and most active region, displaying some strong spots, and still with a delta configuration. Continued slight separation between leader and trailer portions of the group has been evident in recent hours. AR3081, now in the northwest quadrant, is the next largest region, but relatively inactive, with the trailer portion of the group poorly defined. AR3082 and AR3083 have both shown some weakening in recent hours. AR3079 is weakening quickly as it approaches the southwest limb. The remaining (un-numbered) regions are very small simple spot regions.

A CME associated with one or more flares in short-succession from AR3078 on the 16th has been analysed and may give a glancing blow to Earth early on the 19th, though the bulk of the ejecta appears to pass below Earth. M1 and M2 flares from AR3078 and a filament lift off to the west, on the UTC afternoon of the 17th produced a combination of two notable CMEs, which are modelled to mainly pass below Earth. However, there may still be some possible glancing influence from these later on 19th.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, increased gradually but rather erratically from 380 km/s to around 530 km/s. Density was initially at average or below average levels, but soon rose to average to above average levels, peak 22 ppcc near 17/1700 UTC, associated with the arrival of a CME. The IMF was weak to start, soon increasing to Moderate levels after 17/0200 UTC, continuing in the range 10-18nT thereafter. The north-south component varied weakly to begin with but became more erratic, then strengthened after 17/1600 UTC, ranging between +14nT/-17nT. The phi angle has largely been negative (towards the sun), with a temporary switch to positive (away from the sun) around 17/1800 UTC. Parameters appear to indicate an enhancement around 17/0200 UTC, with a likely CME arrival around 17/1600 UTC. Resultant Geomagnetic activity was Quiet to Unsettled (Kp 1-3), before increasing G1-G2/Minor-Moderate Storm (Kp 5-6) between 17/1500-2400 UTC, as recorded by BGS. Lerwick observatory observed a G3/Strong Storm (K7) at 17/1800-2100 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was predominantly High, with a peak of 4.6e3 pfu at 17/1645 UTC. However, flux levels have now dropped to Moderate then Background following the recent CME arrival. The 24-hour integrated electron fluence was above the Active threshold throughout but with a declining trend.

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Observed fluence value of 1.20e8 integrated pfu at 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate with a slight chance of High levels. The most likely source region for any larger flares would be from AR3078 in the southwest quadrant.

Solar Wind / Geomagnetic Activity: Solar winds are currently at elevated levels due to ongoing CME influence from the 14th and 15th August CME arrival, and probable high speed stream influence from coronal hole 14. The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 1) or early on 19th August (Day 2). Also, the CMEs observed on 17th may give some glancing influence later on 19th, perhaps into early 20th, although this is low confidence. Therefore, solar winds are expected to remain enhanced through much of the period with the HSS and also with the possibility of further CME influences through Day 2, perhaps into Day 3. Wind speeds should then begin to decline into Day 4 (21st Aug).

Corresponding geomagnetic activity is expected to be Active to G1/Minor Storm, with a chance of G2/Moderate Storms and a slight chance of isolated G3/Strong Storms at first on Day 1. A risk of further G1/Minor Storms carries through Day 2 (19th), perhaps into early Day 3 (20th), before reducing more confidently into Day 4 (21st).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event mainly due to AR3078.

High energy electron flux will start will start the period at Background to Moderate levels, with ongoing CME and HSS effects Day 1 through Day 2 (18-19th) likely to suppress flux levels. A rise is possible once again on Day 3 (20th), but this is low confidence. Electron fluence values will start above the Active (1e8 integrated pfu) threshold, but are likely to drop sharply on Day 1, probably below Active levels. They are most likely to stay below during Days 2 to 4, although uncertainty over the magnitude of any further CME influences gives low confidence..

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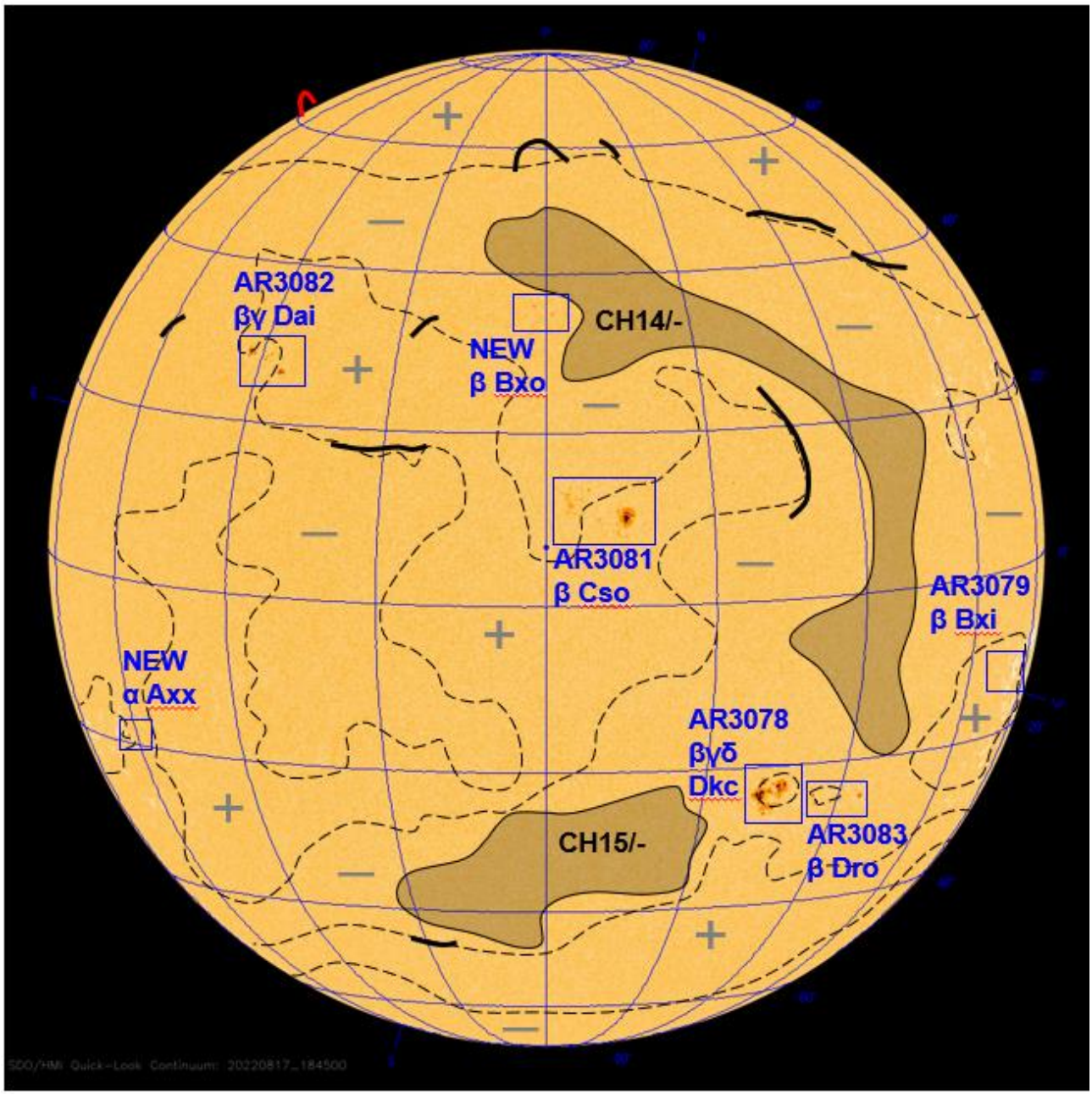
Figure 1. Solar Analysis Valid 17/1900 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are currently at elevated levels due to ongoing CME influence from the 14th and 15th August CME arrival, and probable high speed stream influence from coronal hole 14. The combined effect of one or more CMEs that left the sun on the 16th August may give a glancing blow at Earth either late on the 18th (Day 1) or early on 19th August (Day 2), although the bulk of the ejecta is likely to pass below Earth. Also, the CMEs observed on 17th may give some glancing influence later on 19th, perhaps into early 20th, although this is low confidence and most of the ejecta is again modelled to pass below the Sun-Earth line. Therefore, solar winds are expected to remain enhanced through much of the period with the HSS and also with the possibility of further CME influences through Day 2, perhaps into Day 3. Wind speeds should then begin to decline into Day 4 (21st Aug).

Corresponding geomagnetic activity is expected to be Active to G1/Minor Storm, with a chance of G2/Moderate Storms and a slight chance of isolated G3/Strong Storms at first on Day 1. A risk of further G1/Minor Storms carries through Day 2 (19th), perhaps into early Day 3 (20th), before reducing more confidently into Day 4 (21st).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	80	50	20	5
Strong	G3	No	15	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0740 UTC	Partial	AR3078	South centre disc	607 km/s	19/0001 UTC +/- 12 hours	Glancing blow possible

Figure 2: BGS plot of planetary K (Kp) for past 7 days.

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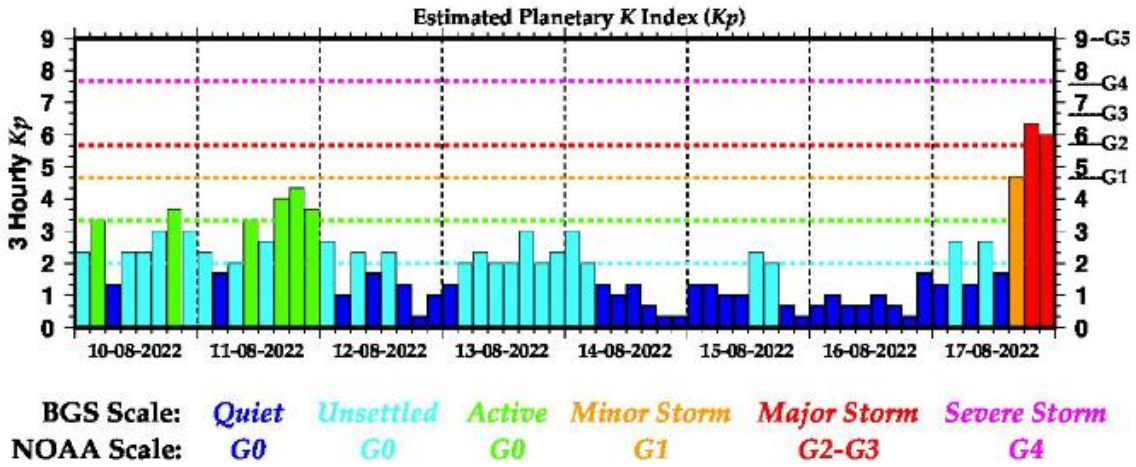
Met Office Space Weather Technical Forecast



Radio Blackouts - X-Ray Flares:

Solar activity is currently Moderate, mainly due to activity from AR3078 (Dkc/Beta-Gamma-Delta). Activity is likely to remain Moderate, with a slight chance of becoming High over the coming days. Other regions of interest include AR3082 (Dao/Beta-Gamma) in the northeast quadrant, as well as AR3083 (Dro/Beta) in the southwest and AR3081 (Cso/Beta) now in the northwest quadrant. However, these areas have significantly less magnetic complexity than AR3078 and as such have a lower flare risk. Other regions appear to be stable or in decay. There is a slight reduction in flare probabilities into Day 4 as a two of the current sunspot regions are expected to have rotated over the sun's western limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. AR3078 carries the main, albeit slight, risk of proton events and as it transits further westward, the risk increases very slightly through the period. There is a very small contribution to the risk from AR3079 and AR3081.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)

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Active	**≥ S1**	No	10	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) will start the period at Background to Moderate levels. During Day 1 (18th) ongoing high speed stream and CME influence is expected to suppress flux levels due to both geomagnetic effects and deformation of the van Allen belt. A further potential CME arrival later Day 1 or early Day 2 (18-19th) may continue the suppressed flux levels, with further possible glancing CME effects through the 19th into early Day 3 (20th). A rise is possible during Day 3 (20th) as geomagnetic activity begins to subside, but confidence is low by this time.

Electron fluence values will start above the Active (1e8 integrated pfu) threshold, but are likely to drop sharply with the ongoing HSS and CME influences, probably below Active levels. They are most likely to stay below during Days 1 and 2, perhaps with a rise later on Day 3, although this is low confidence. REFM forecast values are currently too low, and this model won't be taking account of the CME effects. Therefore REFM trends should not be relied upon through this period.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	90	30	40	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM output

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